PATENT SPECIFICATION 1 399 370

1 399 370

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(19)

(54) MOTOR VEHICLE LAYSHAFT GEARBOX

(71) We, FORD MOTOR COMPANY LIMITED, of Eagle Way, Brentwood, Essex CM13 3BW, a British Company, do hereby declare the invention for which we pray may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a motor vehicle layshaft gear box in which gear selection is effected by a fluid actuator.

According to the invention the fluid actuated layshaft gear box has the following features:—

(a) a selector mechanism of the gear box is mechanically connected to a fluid actuator;

(b) the actuator comprises a composite piston working in a cylinder;

(c) the cylinder has a main section and an adjacent control section of greater diameter than the main section;

(d) the composite piston comprises a main piston and control piston slidable relative to the main piston;

(e) the main piston works in the main section of the cylinder and control piston works in the control section of the cylinder;

(f) the control piston is engageable with a shoulder between the main and control sections of the cylinder to define an intermediate position of the main piston;

(g) the cylinder has a first inlet to the

(g) the cylinder includes a second control section adjacent to and of greater diameter than the first control section;

(h) a second control piston works in the second control section and both the first and second control pistons are slidable on an extension of the main piston of smaller diameter than the main piston.

The invention will now be described with reference to the accompanying drawings in which:—

[*Price 33p*]

Figure 1 is a perspective view of a fluid actuator mechanism for a layshaft gearbox embodying the invention;

Figures 2 to 5 are sections of the cross-gate actuator, each figure showing the actuator in a different position;

Figure 6 is a diagram of the gear positions of the gearbox of Figure 1; and

Figure 7 is a cross-section of the in-gear actuator of the embodiment of Figure 1.

A six-speed gearbox for a truck has a single selector rail 10. Angular movement of the selector rail moves the selector mechanism across the gate of the gearbox and longitudinal movement of the selector rail either forwardly or rearwardly of the vehicle in which the gearbox is installed effects engagement of a gear in accordance with the cross-gate position of the selector rail. The various positions of the selector rail for engagement of the various gears are illustrated diagrammatically in Figure 6. A cross-gate actuator lever 11 is pivotally mounted on the gearbox housing for movement about axis X. A cylindrical portion 12 at one end of the actuator lever 11 engages a recess 13 in a block 14 fixed to the selector rail 10. The recess 13 and the cylindrical portion 12 extend axially to the selector rail parallel to axis X so that longitudinal movement of the selector rail may take place.

The other end of the actuator lever 11 is connected to a composite piston 15 of a cross-gate fluid actuator 16. The cross-gate actuator 16 has three fluid inlets A, B and C. Application of high pressure oil selectively to the inlets A, B and C causes the piston 15 to assume one of four different positions illustrated in Figures 2 to 5. Movement of the piston 15 causes angular movement of the selector rail between the cross-gate positions of the gearbox.

An in-gear actuator lever 17 similar to the cross-gate actuator lever 11 but

pivotally mounted on the gearbox for movement about an axis Y perpendicular to axis X has a cylindrical portion 18 which engages a recess 19 in the block 14. The cylindrical portion 18 and recess 19 extend substantially parallel to the axis Y.

The other end of the in-gear actuator lever 17 is connected to a composite piston 20 of an in-gear fluid actuator 21 which has three fluid inlets D, E and F. Admission of fluid selectively to these fluid inlets causes the piston 20 to assume one of four different positions. One of these positions corresponds to the neutral condition of the gearbox, one position corresponds to gears 1, 3 and 5, another position corresponds to gears 2, 4 and 6, and the other position corresponds to reverse gear which requires less travel for selection than gears 2, 4 and 6.

The fluid actuators used for in-gear actuation and cross-gate actuation differ in detail because of the different relative positions which they are required to provide. It will be appreciated that whereas the cross-gate actuator provides four more or less equally spaced positions the in-gear actuator is required to provide three equally spaced positions with a further position interposed between two of these positions.

A gear box including an actuator of the same type as the cross-gate actuator 16 is described and claimed in our co-pending application No. 41698/72 (Serial No. 1 399 369) from which the subject matter of the present application has been divided out.

The cross-gate actuator 16 comprises a cylinder body 22 having a main section 23 and a control section 24. A main piston 25 of the composite piston 15 works in the main cylinder 23. A control piston 26 is slidably mounted for movement on a reduced diameter portion 27 between the main piston 25 and end stop 28.

Thus the control piston 26 is movable relative to the piston 25 between a shoulder 29 at one end of the main piston 25 and the end stop 28. The control piston 26 is movable relative to the cylinder body 22 between a shoulder 30 at one end of the main cylinder and a shoulder 31 at the other end of the control cylinder 24.

As shown in Figure 2 applying high pressure oil to inlet A causes the main piston 25 to move to its extreme position abutting the end of the main cylinder 23. In this position the control piston 26 is in engagement with the shoulder 30. This position of the actuator corresponds to the cross-gate position for selection of first gear and second gear.

As shown in Figure 3 application of high pressure oil to inlets A and C causes the control piston to engage the shoulder 30 and the main piston to engage the control piston 26 because the area of the main piston is greater than the area of the reduced portion 27. This provides an intermediate position of the actuator corresponding to the cross-gate position for selection of third and fourth gears.

As shown in Figure 4 the application of high pressure oil to inlet B causes the control piston to engage shoulder 31 and the main piston to be urged away from the control piston bringing the end stop 28 into engagement with the control piston 26. This intermediate position of the actuator corresponds to the cross-gate position required for selection of fifth and sixth gears.

As shown in Figure 5 application of high pressure oil to inlet C alone causes the main piston to engage the control piston which in turn engages the shoulder 31. This position of the actuator corresponds to the cross-gate position necessary for selection of reverse gear.

Referring now to Figure 7 the composite piston 20 of the in-gear actuator 21 works in a cylinder body 32 having a main cylinder 33, a first control cylinder 34 of larger diameter than the main cylinder 33, and a second control cylinder 35 of larger diameter than the first control cylinder 34. The composite piston 20 comprises a main piston 36 and first and second control pistons 37 and 38 working respectively in the first control cylinder 34 and the second control cylinder 35. The two control pistons 37 and 38 are slidably mounted on a rod 39 fixed to and of a smaller diameter than the main piston 36.

Figure 7 illustrates the actuator position for selecting first, third and fifth gears. This position is achieved by applying high pressure oil to inlet F thereby urging the piston 36 to one of its extreme positions.

By applying high pressure oil to all three inlets D, E and F the first control piston 37 is urged against shoulder 40 and the main piston 36 is urged against the first control piston 37. This gives the cross-gate position of the actuator mechanism. An exhaust connection 43 permits oil to enter or leave the space between the main piston and the first control piston.

By applying high pressure oil to inlets D and F the second control piston 38 is urged into engagement with shoulder 41 and the main piston 36 engages the first control piston 37 and moves it into engagement with the control piston 38. This gives the intermediate position of the actuating position which corresponds to reverse gear.

Engagement of gears 2, 4 and 6 is achieved by applying pressure to inlet D alone so that the main piston engages the first control piston 37 which in turn en-

gages the second control piston 38 which is moved into engagement with a shoulder 42.

The input of high pressure oil signals to the actuator mechanism may be controlled by a hand operated valve device to provide a manually controlled power shift. In this case the gear box would be a crash gear box or be provided with internal mechanical synchronisation.

Alternatively the gear box may use an external synchroniser arranged to inhibit operation to the fluid actuators until the required gears of the gearbox are synchronised. Such a system is described in our United Kingdom Patent No: 1 253 960. The actuator mechanism described above can also be used to provide a fully automatic transmission. In this case the supply of pressurised fluid to the actuators is controlled by an electronic system in accordance with a number of vehicle operating parameters.

WHAT WE CLAIM IS:—

1. A fluid actuated layshaft gear box in which:—

(a) a selector mechanism of the gear box is mechanically connected to a fluid actuator;

(b) the actuator comprises a composite piston working in a cylinder;

(c) the cylinder has a main section and an adjacent control section of greater diameter than the main section;

(d) the composite piston comprises a main piston and control piston slidable relative to the main piston;

(e) the main piston works in the main section of the cylinder and control piston works in the control section of the cylinder;

(f) the control piston is engageable with a shoulder between the main and control section of the cylinder to define an intermediate position of the main piston;

(g) the cylinder includes a second control section adjacent to and of greater diameter than the first control section; and

(h) a second control piston works in the second control section and both the first and second control pistons are slidable on an extension of the main piston of smaller diameter than the main piston.

2. A gear box as claimed in Claim 1 in which a further intermediate position of the main piston is defined by engagement of the second control piston with the end of the second control section adjacent the first control section and by engagement of the first control piston with the second control piston and engagement of the main piston with the first control piston.

3. A gear box as claimed in Claim 2 in which one extreme position of the main piston is defined by engagement of the main piston with the first control piston, engagement of the first control piston with the second control piston and the second control piston with the end of the second section remote from the first control section.

4. A gear box as claimed in Claim 3 in which the other extreme position is defined by engagement of the main piston with the end of the main section remote from the first control section.

5. A gear box as claimed in Claim 4 in which the actuator is operable to move the selector mechanism to engage a gear after the selector mechanism has been moved to one of a number of cross-gate positions.

6. A gear box as claimed in Claim 5 in which the further intermediate position corresponds to selection of reverse gear.

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Chartered Patent Agent.

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3 SHEETS

COMPLETE SPECIFICATION

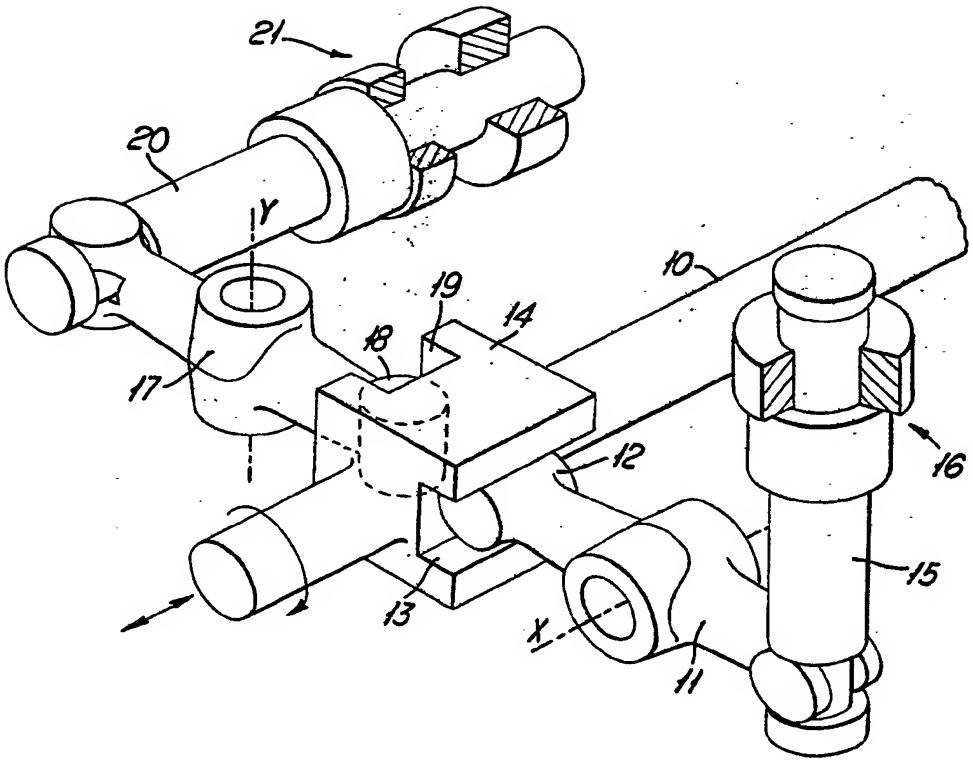

Fig. 1.

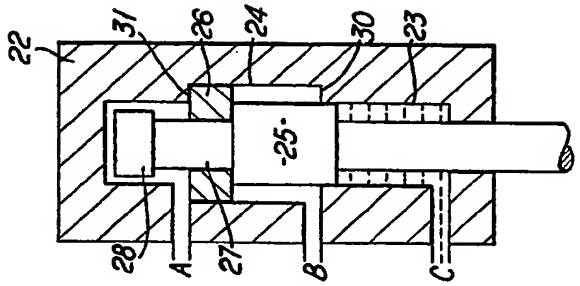

Fig.5.

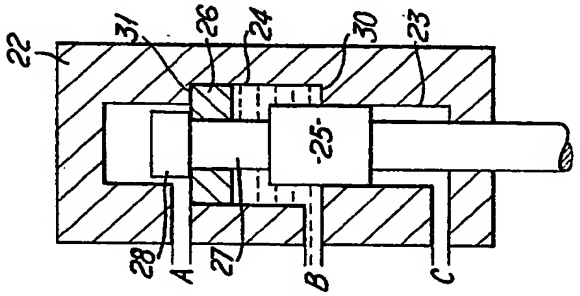

Fig.4.

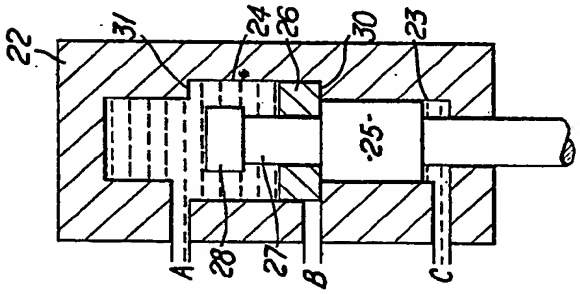

Fig.3.

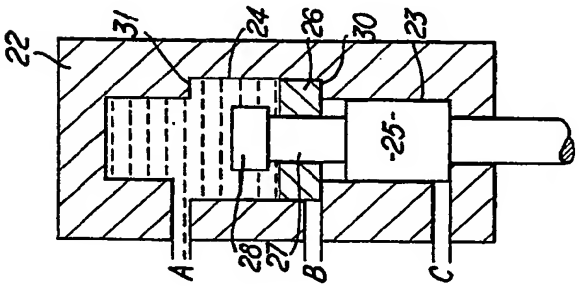

Fig.2.

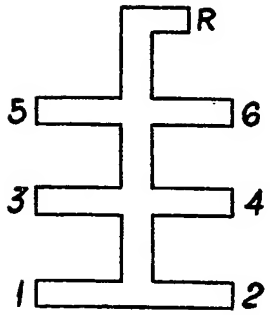

Fig.6.

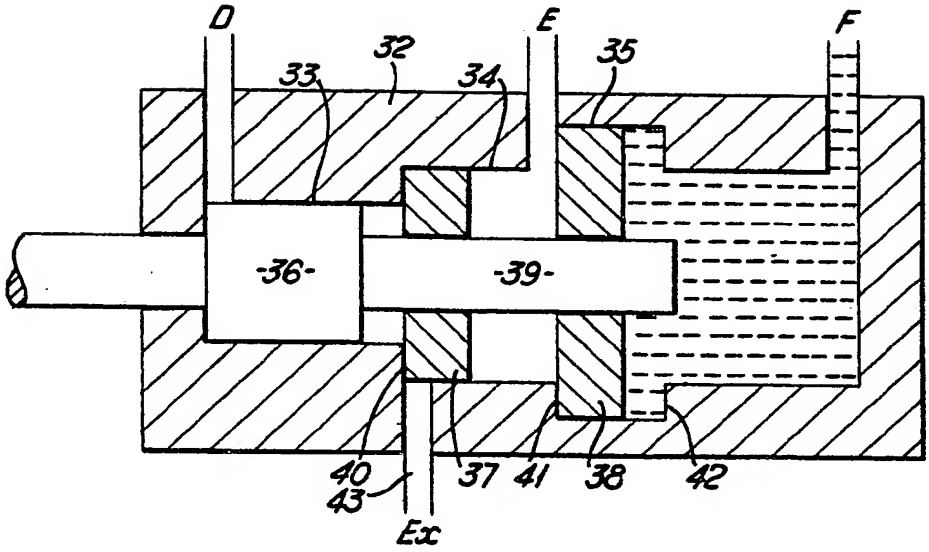

Fig.7.